

Demo board DC365A Quick Start Guide.

I. Introduction

The DC365A demo board is intended to demonstrate the capabilities of the LT5503 RF transmitter IC. This IC incorporates a 1.2 GHz to 2.7 GHz direct I/Q modulator and a 1.7GHz to 2.7GHz mixer. The LT5503 IC operates over a wide supply voltage range, from 5.25V down to 1.8V, and is compatible with the LTC family of WLAN products.

The LT5503 (Figure 1) contains a high frequency quadrature modulator with a variable gain amplifier (VGA), and a balanced up-converting mixer. The modulator includes a precision 90° phase shifter which allows direct modulation of an RF signal by the baseband I and Q signals. Depending on transceiver architecture and other considerations, the up-converting mixer can be used to generate the high-frequency RF input for the modulator by mixing the system's 1st and 2nd local oscillators. The LT5503 modulator output can deliver up to -3dBm at 2.5GHz. The VGA allows output power reduction in three steps, up to 15dB with two control pins. The baseband inputs are internally biased for maximum input voltage swing at low supply voltage. If needed, they can be driven with external bias voltages.

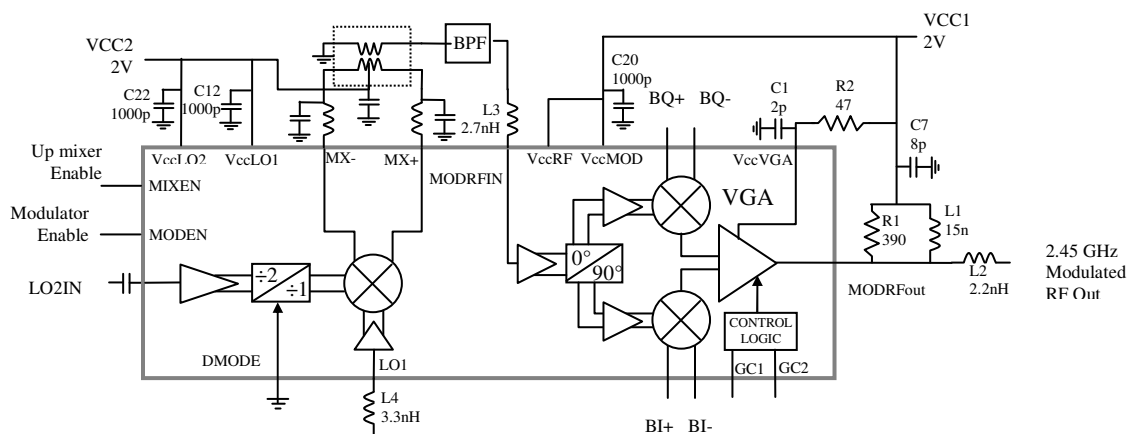


Figure 1. LT5503 IC block diagram.

The DC365A demo board (Figure 2A & 2B) is intended to demonstrate the up-converting mixer and an I/Q modulator independently or in a chain, with the up-converting mixer generating the high-frequency carrier signal for the modulator input. A transceiver application schematic for the up-converting mixer followed by the I/Q modulator is shown in Figure 3. A transceiver application schematic for the direct I/Q modulator in conjunction with a direct conversion receiver is shown in Figure 4. The demo board's modulator input/output matching circuitry is optimized for 2.45 GHz applications. The mixer LO1 input is optimized for 2075 MHz. The mixer LO2 input is broadband without external matching circuitry. Values for 1.2 GHz and 1.9 GHz frequencies are available in the application notes of the LT5503 data sheet.

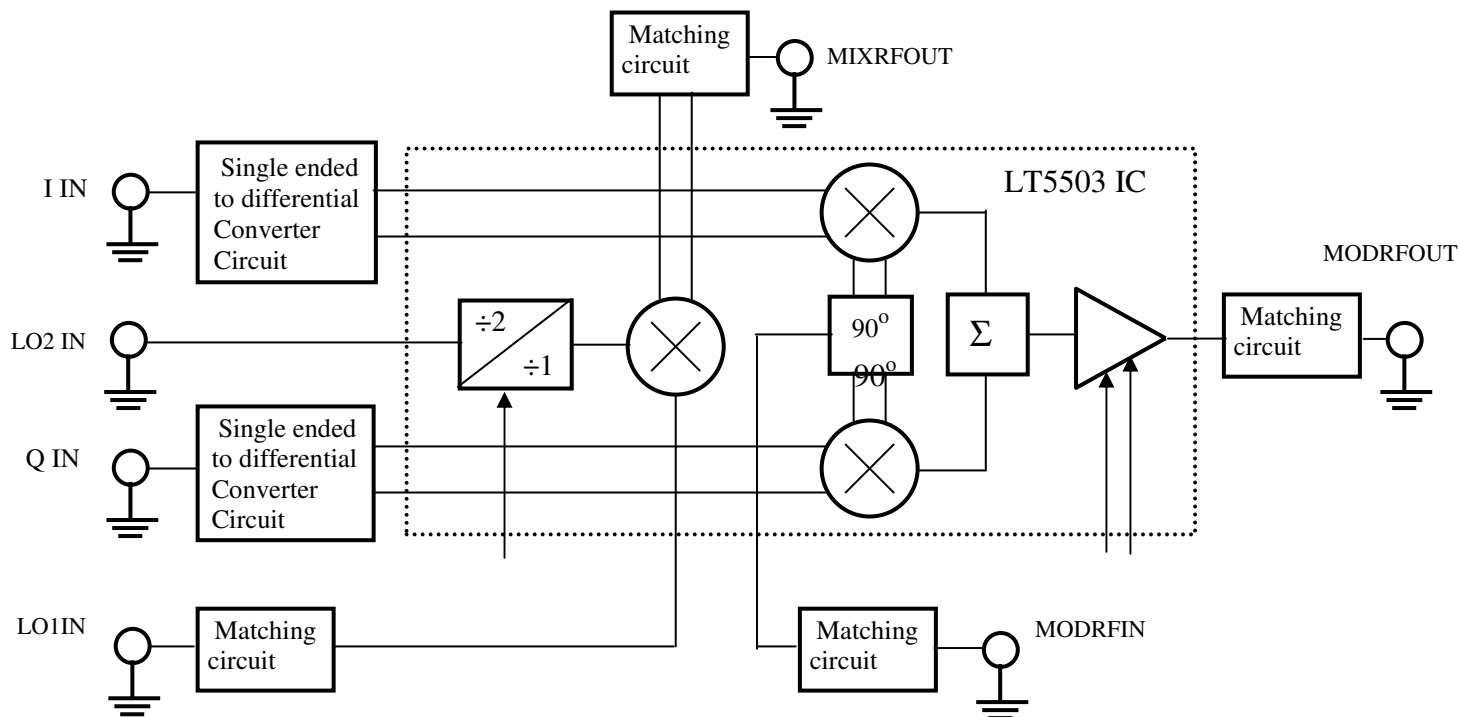


Figure 2A. Demo board DC365A block diagram.

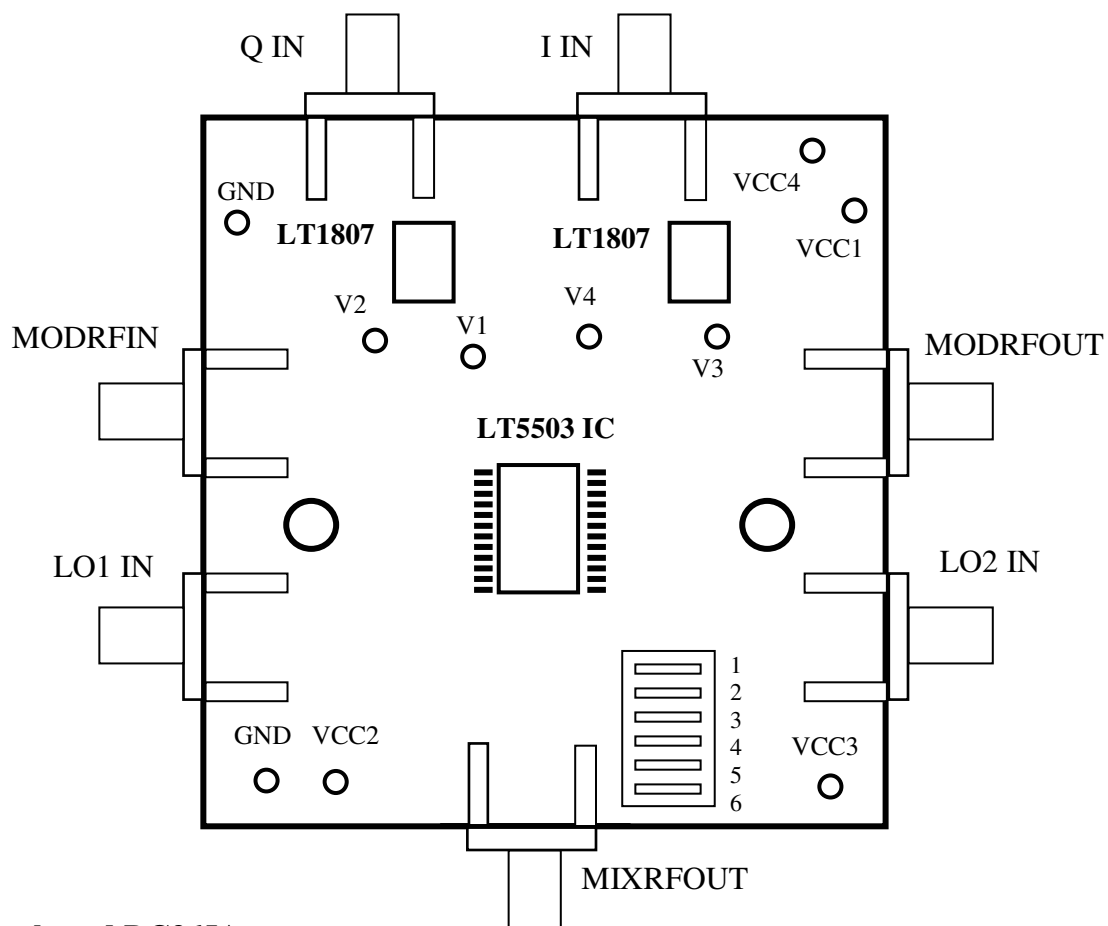


Figure 2B. Demo board DC365A.

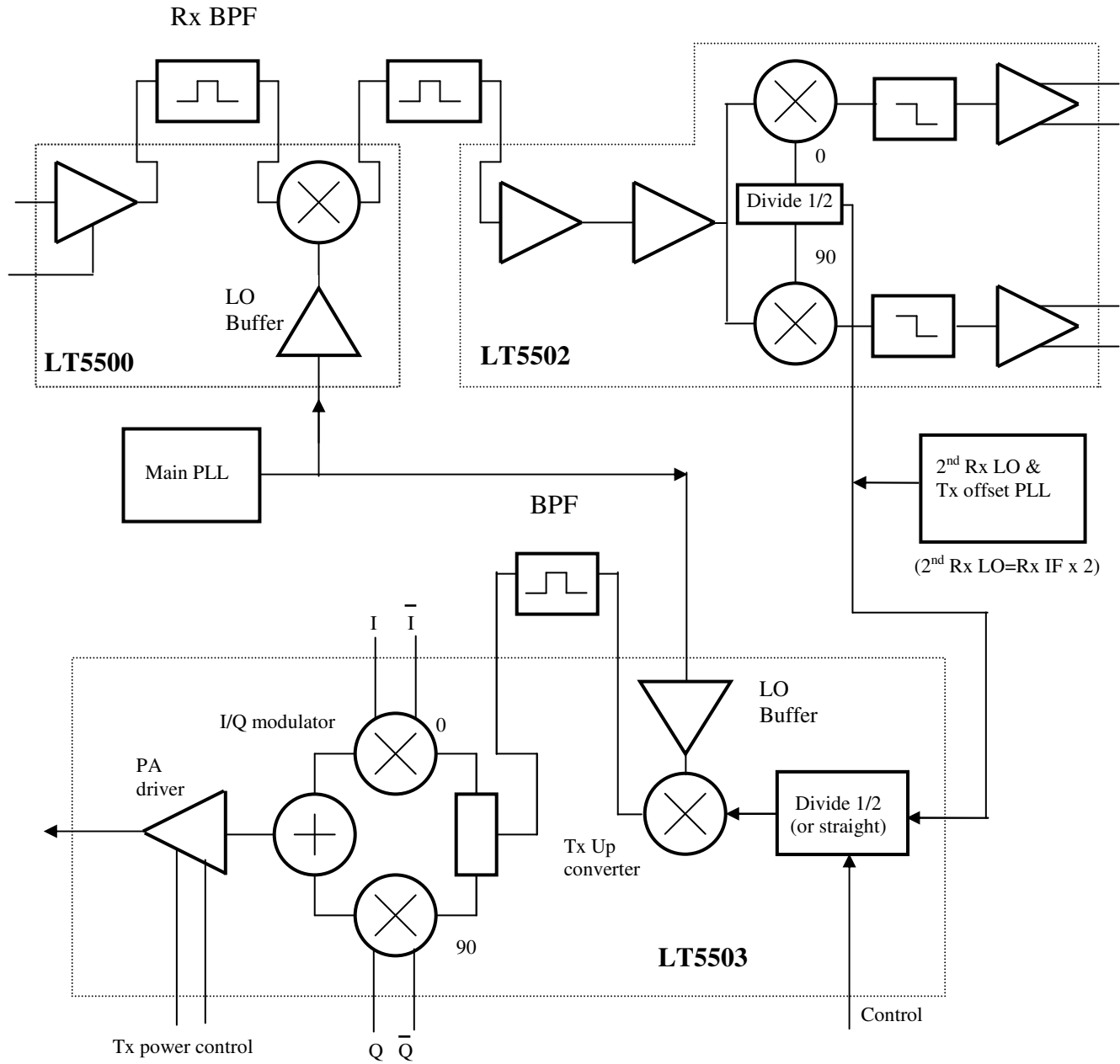


Figure 3. LT5503 transceiver implementation with super heterodyne receiver.

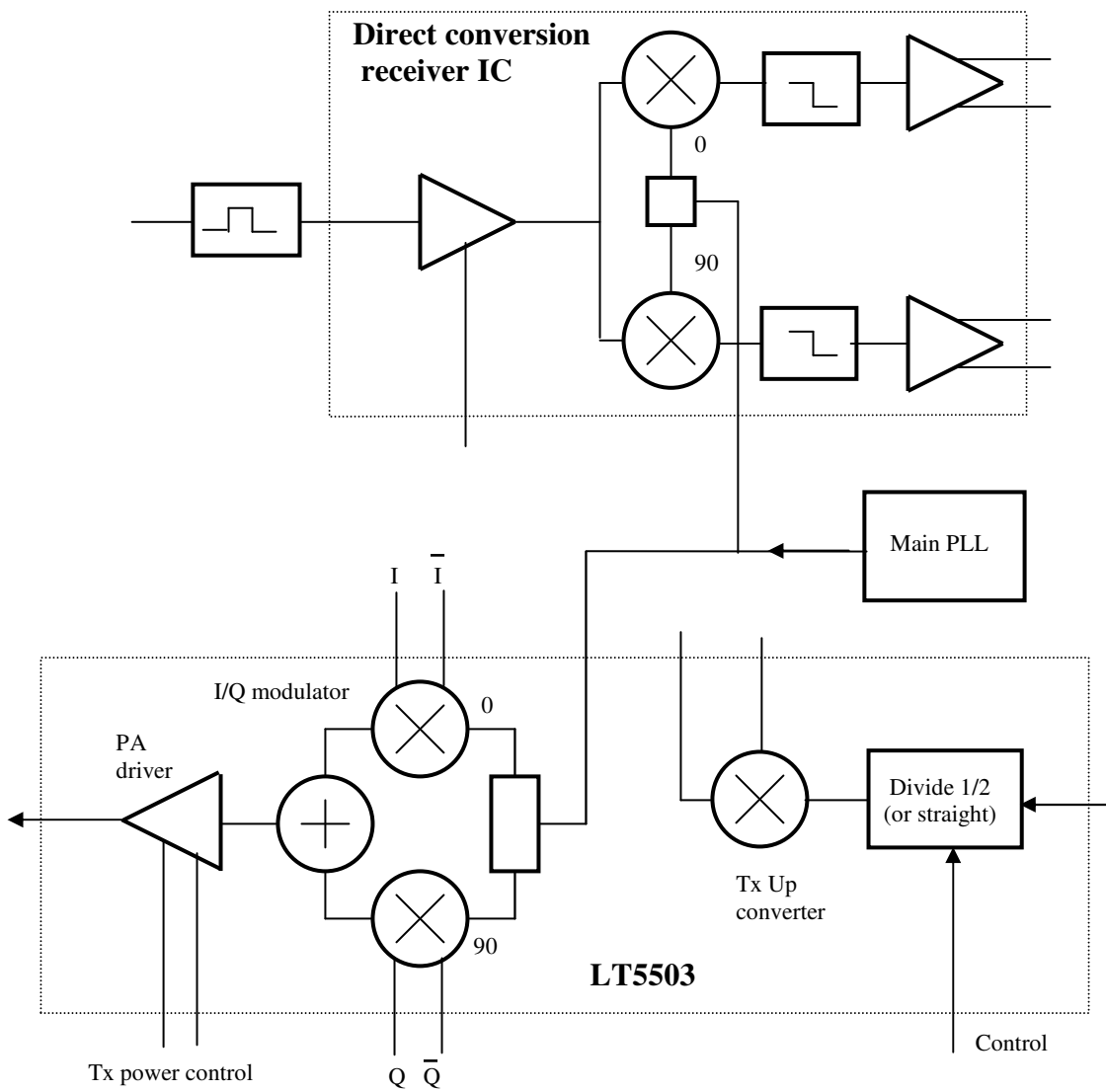


Figure 4. LT5503 transceiver implementation with direct conversion receiver.

II. Applications and implementation issues.

I/Q inputs external circuitry (refer to demo board schematic).

The external I/Q input circuitry is provided to convert single ended input modulation signals to differential signals to best utilize the differential I/Q inputs of the LT5503 IC. If desired by users, the external I/Q input circuitry can be configured to provide single-ended to single ended buffering only. In this case, capacitors C17 and C18 should be removed and capacitors C41 and C42 should be placed on the demo board. C41 and C42 provide RF ground to unused I/Q ports.

Control signals for demo board dipswitch block (numbers marked on the body of the dipswitch):

		Modulator RF output power	Maximum	-4.5 dB	-9.0 dB	-13.5 dB
1 st	GC1	least significant bit of modulator output power control	LOW	HIGH	LOW	HIGH
2 nd	GC2	most significant bit of modulator output power control	LOW	LOW	HIGH	HIGH

		LOGIC STATE	LOW	HIGH
3 ^d	DMODE	Mixer 2 nd LO divider mode control	DIVIDE-BY-2	DIVIDE-BY-1
4 th	MixEN	Mixer Enable	MIXER DISABLED	MIXER ENABLED
5 th	ModEN	Modulator Enable	MODULATOR DISABLED	MODULATOR ENABLED
6 th	not used			

III. LT5503 up converting mixer basic tests and measurements for 2.45 GHz band. NOTE: 2.45 GHz demo board version should be used.

1. Connect all the test equipment and power supplies as shown on Figure 5.
2. Set power supply #2 and power supply #3 to desired supply voltage from 1.8 to 5.25 volts. NOTE: One power supply can be used if desired.
3. Set dipswitch #4 to logic state LOW. Mixer is in OFF state. Measure supply current for mixer OFF state.
4. Set dipswitch #4 to logic state HIGH. Mixer is in ON state. Measure supply current for mixer ON state.
5. Set dipswitch #3 to logic state LOW for divide-by-2 setting for LO2 input. Set Signal Generator 2 for F = 750 MHz, Pout = -18 dBm CW signal.
6. Set Signal Generator #1 for F = 2075 MHz, Pout = -12 dBm CW signal.
7. Set Spectrum Analyzer for center frequency 2450 MHz. Perform mixer conversion gain and LO1/LO2 leakage measurements. Repeat measurements with different RF input power levels for LO1 and LO2 ports.
8. Set dipswitch #3 to logic state HIGH for divide-by-1 setting for LO2 input. Set Signal Generator 2 for F = 375 MHz, Pout = -18 dBm CW signal.
9. Repeat measurements of step 7.

IV. LT5503 up converting mixer basic tests and measurements for 1.9 GHz band.

NOTE: 1.9 GHz demo board version should be used.

1. Connect all the test equipment and power supplies as shown on Figure 5.
2. Set power supply #2 and power supply #3 to desired supply voltage from 1.8 to 5.25 volts.
NOTE: One power supply can be used if desired.
3. Set dipswitch #4 to logic state LOW. Mixer is in OFF state. Measure supply current for mixer OFF state.
4. Set dipswitch #4 to logic state HIGH. Mixer is in ON state. Measure supply current for mixer ON state.
5. Set dipswitch #3 to logic state LOW for divide-by-2 setting for LO2 input. Set Signal Generator 2 for $F = 480$ MHz, $P_{out} = -18$ dBm CW signal.
6. Set Signal Generator #1 for $F = 1660$ MHz, $P_{out} = -12$ dBm CW signal.
7. Set Spectrum Analyzer for center frequency 1900 MHz. Perform mixer conversion gain and LO1/LO2 leakage measurements. Repeat measurements with different RF input power levels for LO1 and LO2 ports.
8. Set dipswitch #3 to logic state HIGH for divide-by-1 setting for LO2 input. Set Signal Generator 2 for $F = 240$ MHz, $P_{out} = -18$ dBm CW signal.
9. Repeat measurements of step 7.

V. LT5503 I/Q modulator basic tests and measurements for 2.45 GHz band.

NOTE: 2.45 GHz demo board version should be used.

1. Connect all the test equipment and power supplies as shown on Figure 6.
2. Set power supply #4 to provide voltage from 3.5 to 5.25 volts.
NOTE: This power supply provides V_{cc} to two LT1807 op-amps ICs that perform single ended to differential conversion for the LT5503 modulator differential I/Q inputs.
3. Set power supply #1 and power supply #3 to desired supply voltage from 1.8 to 5.25 volts.
NOTE: Single power supply can be used if desired to provide supply #1 and supply #3.
4. Set dipswitches #1 and #2 to logic state LOW/LOW (modulator maximum power output).
5. Set dipswitch #5 to logic state LOW. Modulator is in OFF state. Measure supply current for modulator OFF state.
6. Set dipswitch #5 to logic state HIGH. Modulator is in ON state. Measure supply current for modulator ON state.
7. Set Dual Signal Generator for $F = 100$ KHz, $V_{out} = 500$ mV p-p CW signals. Signal for I channel should be programmed for 0° phase. Signal for Q channel should be programmed for 90° phase. NOTE: Dual Signal Generator should have 50-ohm output impedance.
8. Set Signal Generator for $F = 2450$ MHz, $P_{out} = -16$ dBm CW signal.
9. Set Spectrum Analyzer for center frequency 2450 MHz. Frequency span should be set for 1.0 MHz. Measure modulator RF output USB, LSB and Carrier signals. Repeat measurements with different RF input power levels for MODIN.
10. Repeat measurements of step #9 for three other power output settings (dip switches #1 & #2 logic states LOW/HIGH, HIGH/LOW & LOW/LOW).

VI. LT5503 I/Q modulator basic tests and measurements for 1.9 GHz band.

NOTE: 1.9 GHz demo board version should be used.

1. Connect all the test equipment and power supplies as shown on Figure 6.
2. Set power supply #4 to provide voltage from 3.5 to 5.25 volts.
NOTE: This power supply provides V_{cc} to two LT1807 op-amps ICs that perform single ended to differential conversion for LT5503 modulator differential I/Q inputs.
3. Set power supply #1 and power supply #3 to desired supply voltage from 1.8 to 5.25 volts.
4. Set dipswitches #1 and #2 to logic state HIGH/HIGH (modulator maximum power output).
5. Set dipswitch #5 to logic state LOW. Modulator is in OFF state. Measure supply current for modulator OFF state.
6. Set dipswitch #5 to logic state HIGH. Modulator is in ON state. Measure supply current for modulator ON state.
7. Set Dual Signal Generator for $F = 100$ KHz, $V_{out} = 500$ mV p-p CW signals. Signal for I channel should be programmed for 0° phase. Signal for Q channel should be programmed for 90° phase. NOTE: Dual Signal Generator should have 50 ohm output impedance.
8. Set Signal Generator for $F = 1900$ MHz, $P_{out} = -16$ dBm CW signal.
9. Set Spectrum Analyzer for center frequency 1900 MHz. Frequency span should be set for 1.0 MHz. Measure modulator RF output USB, LSB and LO signals. Repeat measurements with different RF input power levels for MODIN.
10. Repeat measurements of step #9 for three other power output settings (dip switches #1 & #2 logic states LOW/HIGH, HIGH/LOW & LOW/LOW).

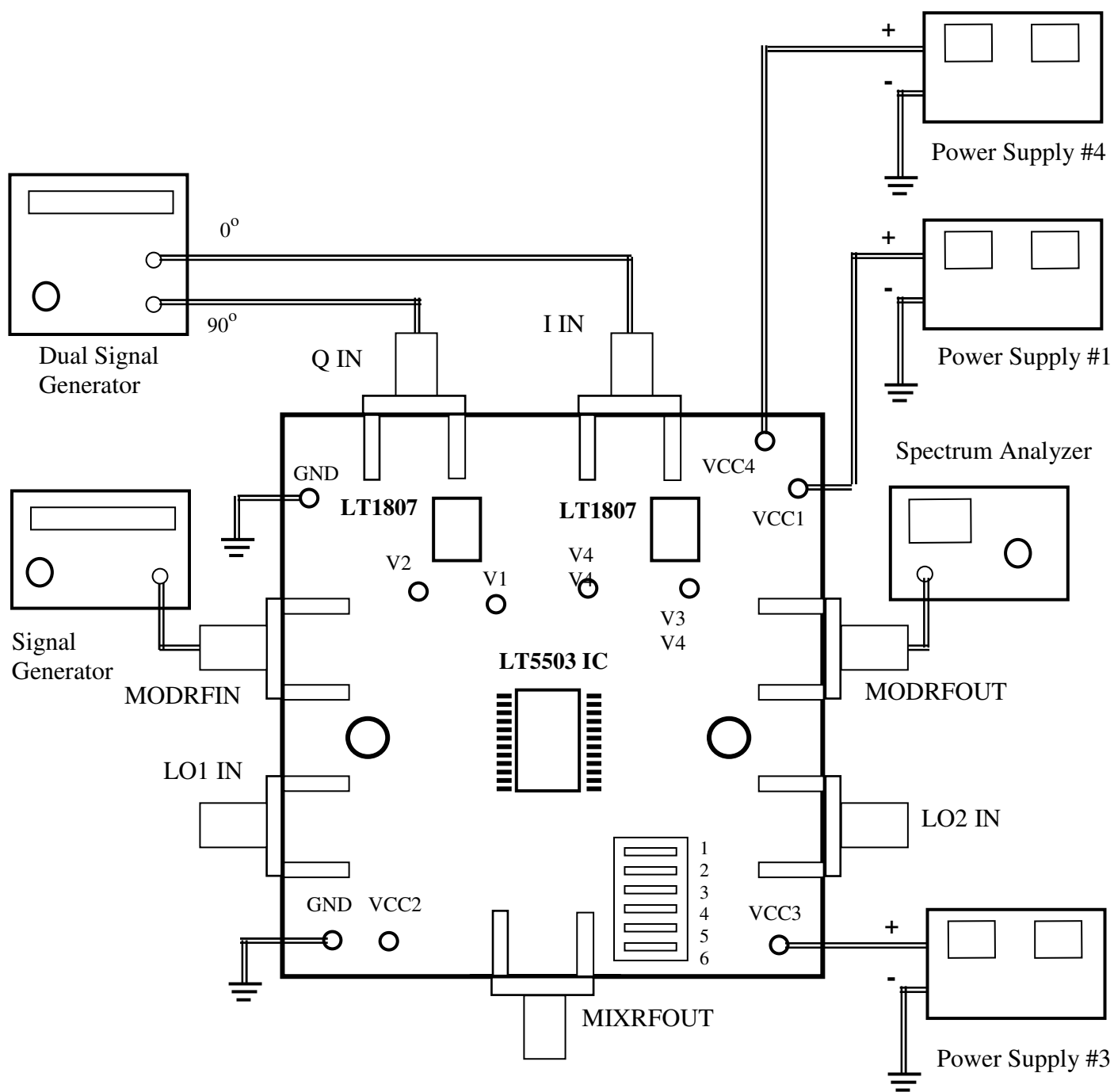


Figure 6. Test set up for LT5503 I/Q modulator measurements.

VII. LT5503 up converting mixer and I/Q modulator (connected in chain) basic tests and measurements for 2.45 GHz band.

NOTE: 2.45 GHz demo board version should be used.

1. Connect all the test equipment and power supplies as shown on Figure 7.
2. Set power supply #4 to provide voltage from 3.5 to 5.25 volts.
3. Set power supplies #1, #2 & #3 to desired supply voltage from 1.8 to 5.25 volts. NOTE: One power supply can be used if desired for power supplies #1, #2 & #3. For tests with power supply voltages 3.5 to 5.25 volts one power supply can be used if desired for power supplies #1, #2, and #3 and power supply #4.
4. Set dipswitch #4 to logic state HIGH. Mixer is in ON state.
5. Set dipswitch #5 to logic state HIGH. Modulator is in ON state.
6. Set dipswitch #3 to logic state LOW for divide by 2 setting for LO2 input. Set Signal Generator 2 for $F = 750 \text{ MHz}$, $P_{out} = -10 \text{ dBm}$ CW signal.
7. Set Signal Generator #1 for $F = 2075 \text{ MHz}$, $P_{out} = -10 \text{ dBm}$ CW signal.
8. Connect 3 dB attenuator pad between up converting mixer output and modulator input. If desired, 2.45 GHz bandpass filter can be used instead to filter out mixing spurious products.
9. Set dipswitches #1 and #2 to logic state LOW/LOW (modulator maximum power output).
10. Set Dual Signal Generator for $F = 100 \text{ KHz}$, $V_{out} = 500 \text{ mV p-p}$ CW signals. Signal for I channel should be programmed for 0° phase. Signal for Q channel should be programmed for 90° phase. NOTE: Dual Signal Generator should have 50-ohm output impedance.
11. Set Spectrum Analyzer for center frequency 2450 MHz. Frequency span should be set for 1.0 MHz. Measure modulator RF output USB, LSB and LO signals.
12. Repeat measurements of step #11 for three other RF power output settings (dip switches #1 & #2 logic states LOW/HIGH, HIGH/LOW & HIGH/HIGH).

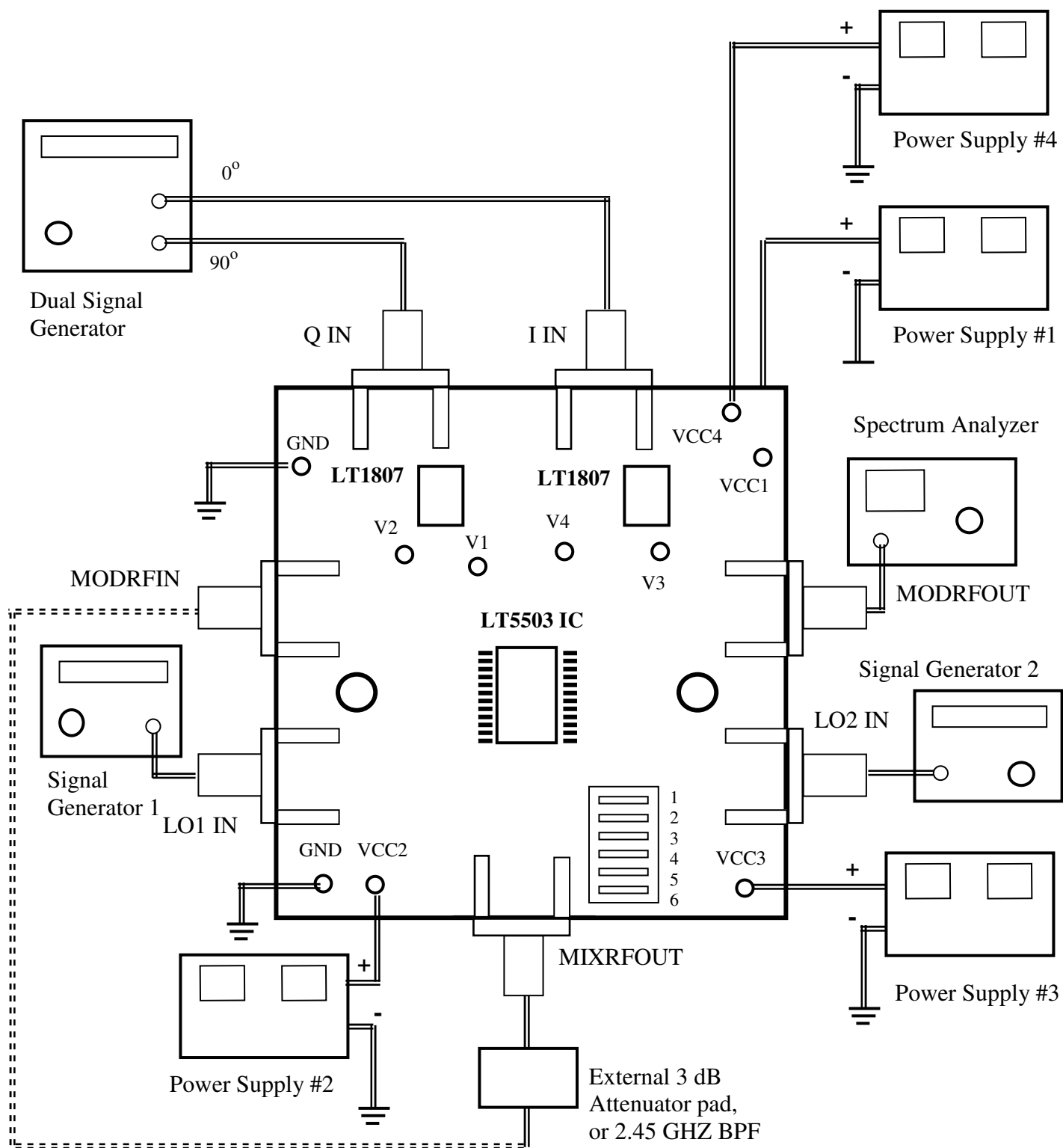


Figure 7. Test set up for LT5503 up converting mixer & I/Q modulator chain measurements.